Citation:

Ellekjaer H, Holmen J, Vatten L. Blood pressure, smoking and body mass in relation to mortality from stroke and coronary heart disease in the elderly. A 10-year follow-up in Norway. *Blood Pressure* 2001; 10: 156-163.

PubMed ID: 11688763

Study Design:

Prospective cohort

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the association between blood pressure, smoking and BMI and cerebrovascular and cardiovascular mortality in a population of healthy elderly.

Inclusion Criteria:

Participants in the Nord-Trondelag Health Study, 70 years or older.

Exclusion Criteria:

- Those with previous diagnosis of angina, MI, stroke or DM
- Use of blood pressure medicine.

Description of Study Protocol:

Between 1984-1986, a general health survey was conducted among men and women 20 years and older in Nord-Trondelag county in Norway. Among 85,100 questionnaires, 77,310 were returned and 77,977 participated in a health examination. At the exam, a second questionnaire was handed out, 5,441 men and 6,729 women, age 70 and over, attended and received the questionnaire. 98.5% answered questions related to stroke, diabetes,CHD, and use of blood pressure medication at home. Those with a previous diagnosis of angina, MI, stroke or DM were excluded. 3,121 men and 3,271 women were eligible for follow-up.

Height and weight, as well as blood pressure, were measured by specially trained nurses. Current smoking information was available.

- *Anthropometric:* Height and weight
- *Blinding used:* No

- *Statistical tests:*
  - Cox-regression analysis was used to calculate age- and multivariate-adjusted risk ratios for death of stroke and CHD-associated with systolic blood pressure, diastolic blood pressure, current smoking, BMI in sex-specific quartiles
  - 95% Confidence Interval
  - Significance at $P<0.05$.

Data Collection Summary:

Timing of Measurements

- Risk factors for stroke and coronary heart disease were collected by two self-administered questionnaires at baseline as well as smoking status
- Height, weight, BMI calculation and blood pressure measurement were done at baseline
- Cause-specific death was determined (median time of follow-up was 9.1 years, mean was 7.7 years).

Dependent Variables

- Mortality: Obtained from the register of deaths at Statistics Norway
  - Stroke
  - Coronary heart disease
  - Death from other causes.

Independent Variables

- Blood pressure
  - Systolic
    - Less than 140mmHg (reference group)
    - 140 to 159mmHg
    - 160 to 179mmHg
    - Greater than or equal to 180mmHg
  - Diastolic
    - Less than 90mmHg (reference group)
    - 90 to 99mmHg
    - 100 to 109mmHg
    - Greater than or equal to 110mmHg
- Current smoking (yes/no)
- BMI
  - Less than or equal to 23.23kg per m^2
  - 23.24 to 25.97kg per m^2
  - 25.98 to 29.00kg per m^2
  - Greater than or equal to 29.01kg per m^2
- Gender.

Control Variables

- Gender
- Systolic blood pressure
- Diastolic blood pressure
- BMI.

Description of Actual Data Sample:

- *Initial N:* 6,392
  - 3,121 men
  - 3,271 women
- *Attrition (final N):* 6,392
- *Age:* See table
- *Ethnicity:* Not described
- *Other relevant demographics:* See table
- *Anthropometrics:* See table

Age-Group (years)	Subjects	Mean SBP (SD)	Mean DBP (SD)	Mean BMI (SD)	Current Smokers, %
Men					
70-74	1,398	151.0 (22.5)	87.3 (11.6)	25.4 (3.5)	33.0
75-79	913	154.7 (24.5)	87.8 (12.1)	25.3 (3.4)	24.9
80-94	508	153.9 (24.3)	86.5 (12.3)	25.0 (3.3)	21.0
85+	302	151.62 (27.2)	84.2 (14.5)	24.4 (3.3)	14.7
Women					
70-74	1,415	155.7 (25.0)	87.0 (12.0)	26.5 (4.4)	11.9
75-79	933	158.4 (25.0	86.5 (11.8)	26.6 (4.6)	5.4
80-84	557	162.3 (28)	86.6 (12.6)	25.9 (4.3)	3.1
85+	366	158.5 (29)	83.9 (13.5)	25.1 (4.3)	1.9

- *Location:* Nord-Trondelag county, Norway.

Summary of Results:

No association was found between BMI and mortality from CHD in men or in women.

In women, BMI was negatively associated with cerebrovascular deaths in the age-adjusted analyses (P=0.03), but it was not statistically significant in the multivariate analyses.

A negative association was found between increasing BMI and all-cause mortality in men and women in age-adjusted analyses (both P<0.01), but in multivariate analyses, the negative association was statistically significant only in women (P<0.01).

Men BMI: RR of Death from Cerebrovascular Disease (Age-adjusted by One Year)

BMI (kg/m^2)	RR
<22.95	1.0
22.96-25.10	0.73
25.11-27.35	0.86

≥27.36	0.84

P-value: 0.45

Women BMI: RR of Death from Cerebrovascular Disease (Age-adjusted by One Year)

BMI (kg/m^2)	RR
<23.23	1.0
23.24-25.97	0.85
25.98-29.00	1.13
≥29.01	0.85

P-value: 0.74

Mortality From Stroke

- Among men the multivariate RRs of dying from stroke for those with systolic blood pressure in the categories 160 to 179mmHg and greater than or equal to 180mmHg was 1.63 and 2w.18 compared to systolic blood pressure less than 140mmHg (P<0.01 for trend)
- For women the corresponding RRs were 1.54 and 2.12 (P<0.01 for trend)
- For men the multivariated RRs for the diastolic blood pressure categories 100 to 102 and greater than or equal to 11 mmHg were 1.88 and 3.06 compared to diastolic blood pressure less than 90mmHg (P<0.01 for trend)
- For women, the corresponding RRs wer 1.75 and 2.02 (P<0.01 for trend).

Mortality From Coronary Heart Disease

- In multivariate RRs of dying from CHD for those with systolic blood pressure in the categories 160 to 179mmHg and greater than or equal to 180mmHg was 1.16 and 1.58, compared to systolic blood pressure less than 140mmHg (P<0.01 for trend)
- In women the corresponding RRs were 1.91 and 2.37 (P<0.01 for trend)
- For diastolic blood pressure, men with 100 to 109 and greater than or equal to 110mmHg had multivariate RRs of 1.56 and 1.55 compared to diastolic pressure less than 90mmHg (P=0.01 for trend)
- For women the corresponding RRs were 1.31 and 1.51, but these associations were not statistically significant.

All-cause Mortality

- RRs increased by increasing diastolic blood pressure both in men (P=0.05 for trend) and in women (P<0.01 for trend)
- Increasing systolic blood pressure was positively associated with total mortality only in women (P<0.01 for trend)
- Current smoking increased the risk of dying in both men (RR 1.40, 95% CI 1.24-1.58) and women (RR 1.49, 95% CI 1.17-1.90).

Author Conclusion:

- These findings add to the growing evidence that hypertension is a major risk factor for mortality from stroke and coronary heart disease (CHD) among the elderly and the very old.

High blood pressure among the elderly should not be treated any differently than among younger age groups.
- In itself, BMI was not associated with mortality from stroke and CHD in our population. Relative to total mortality in women, we found a negative association with BMI.

Reviewer Comments:

Strengths:

- *There were adjustments for variables*
- *Credible use of statistics.*

Generalizability/Weaknesses:

- *No data on ethnic composition of sample*
- *No data regarding study factors, such as if smoking status changed over time.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes

2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	N/A
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A

5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes

8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
	8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
	8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	Yes
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		Yes
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	Yes